

UC-1-CIP
PATENT

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15 **WIRELESS NODE MULTIPLE HANDSET CORDLESS TELEPHONE
SYSTEM**

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Liu, F. Inventor

WIRELESS NODE MULTIPLE HANDSET CORDLESS TELEPHONE SYSTEM

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BACKGROUND OF THE INVENTION

Field of the Invention

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[1] The present invention relates to telephones. More specifically, the present invention relates to multiple handset cordless telephones operable within a wireless telephone network.

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Description of the Related Art

[2] Users of modern telephony services have a wide range of products and services available to them. Among these is the conventional wire-line telephone that provides access to the Public Switched Telephone Network ("PSTN"). The classic
20 telephone-set includes a base and a handset. The two are connected together by a cord that carries duplex audio, and sometimes signaling information. The base is further connected to the PSTN with a twisted pair of wires running from the user's telephone location to a telephone company central office. The handset rests on a hook switch on top of a cradle on the base. Over the years, many more convenient features have
25 been added to telephones and telephone services. Cordless telephones were developed, which eliminated the cord between the base unit and the handset, but did not eliminate the twisted pair of wires connecting the base to the central office. In a

cordless telephone, the cord is replaced by a pair of radio transceivers, one in the base and one in the handset, that allow the user to move freely within the radio coverage range of the transceivers. Wireless telephone networks have also been developed and deployed. Wireless networks eliminate the need for interconnection of the telephone terminal unit to the PSTN by a twisted pair of wires. Rather, a network of fixed radio transceivers replaces the wire-line network. Each wireless telephone handset contains a radio transceiver that communicates wirelessly with the wireless network. Wireless telephone networks greatly expand the roaming ability of the users as compared with cordless telephones because the network allows roaming of terminal units between several fixed radio transceivers.

[3] The advent of cordless and wireless telephone service, as well as the dramatic increase in other telephony services, has changed the way people use telephones and their expectations about the convenience of service. Multiple extension systems exist that allow intercom functions as well as shared telephone resource functions. Cordless telephone headsets offer hands-free roaming. Most homes and office have multiple telephone extensions with different types of telephone instruments selected to meet users' desires. Many users have both a wire-line telephone and a wireless telephone. Many homes and offices enjoy the convenience and freedom of movement afforded by cordless telephone service. There is an expectation by users today that telephone service is ubiquitous and that people can be reached virtually anywhere and at anytime.

[4] While there has been a great increase in the range of products and services available to users of telephony services, the increase has not been without some problems and costs. Many users now have wireless telephone number as well as a wire-line telephone numbers. This can lead to confusion and wasted time in attempts

to reach a user when their whereabouts is not known. It is also more expensive to maintain two separate types of telephone service. Many of the convenient services offered by home or office telephone systems are not available with a wireless telephone. For example, multiple extensions, speakerphones, cordless telephone features, and system growth flexibility. Wireless and cordless services do create some user confusion as well. Some users prefer the classic desk type telephone, the so-called "2500 set", as opposed to the more technical user interface that wireless telephones employ. Others prefer advanced telephone instruments, such as cordless headsets or designer products. There are also issues as to battery charging and battery life. Tiny wireless telephones do not lend themselves to large capacity storage batteries that enable extended periods of battery-only operation. Thus, there is a need in the art for a system and method to integrate wireless telephony with conventional wire-line types of features and services while still maintaining the portability and ubiquitous nature of telephony service the users have come to expect.

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SUMMARY OF THE INVENTION

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[5] A wireless telephone node system is taught. The system includes a node having a wireless transceiver that communicates wireless signals, and a first processor that converts wireless audio signals and wireless control signals from the wireless signals. The node also includes a first cordless transceiver that communicates cordless signals, and a second processor that converts two or more cordless audio signals and cordless control signals from the cordless telephone signals. A switch is coupled to connect between the wireless audio signals and the plural cordless audio signals. A

controller is coupled to cause the switch to connect between any pair of the wireless audio signals and the two or more cordless audio signals in response to the wireless control signals or in response to the cordless control signals.

5 [6] In a specific embodiment of the invention, the wireless transceiver operates in compliance with one of the promulgated wireless network signaling protocols. That protocol may be GSM, T-Mobile, CDMA, TDMA, or AMPS protocols. In specific embodiments the first cordless transceiver operates in the 900MHz cordless band, the 1.8 GHz cordless band, the 2.4 GHz cordless band, or the 5.8 GHz band, and in
10 accordance with an analog standard, the PHS, DECT, or DSS standard.

[7] In another embodiment, the node includes a portable housing. A charging circuit with a charging output may be installed in the housing. In a refinement of this embodiment, the housing has a charging cradle formed thereon for engaging a cordless
15 terminal unit. The charging output is aligned to couple to corresponding charging contacts on the cordless terminal unit when engaged with the charging cradle. Further, the charging circuit may include a battery that powers the node as well as providing power to the charging output. In a specific embodiment, a mounting structure is provided that is adapted to support the housing from a vertical surface.

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[8] In an improvement to the node design, a clock and clock display are added to the node. In another improvement, a broadcast radio receiver, such as an AM/FM receiver, having a radio audio output and a radio user interface is included in the node. In a particular embodiment, the radio audio output is coupled to the switch, and the
25 controller operates to cause the switch to connect the radio audio to the wireless transceiver or the cordless transceiver.

[9] The present invention also utilizes specialized cordless terminal units with the node. In one embodiment, the cordless terminal unit includes a second cordless transceiver that communicates cordless signals, including audio signals and control signals, with the first cordless transceiver. It also includes an audio circuit that
5 couples audio signals between the second cordless transceiver and a speaker and microphone. A battery powers the cordless terminal unit. A telephone user interface receives various user inputs, and the user inputs are coupled to the second cordless transceiver as cordless control signals. An enclosure is provided that supports the battery, the second cordless transceiver, and the audio circuit.

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[10] In a particular embodiment of the cordless terminal unit, it includes an ear support structure fixed to the enclosure that supports the cordless terminal on a user's ear. It also includes a microphone support structure fixed to the enclosure for locating the microphone in receptive proximity to a user's mouth while the ear
15 support structure is engaged with the user's ear.

[11] In another embodiment of the cordless terminal unit, the enclosure further includes battery charging contacts disposed on the exterior thereof. The charging contacts are coupled to the battery for charging. The cordless terminal further
20 includes a charging cradle adapted to receive the cordless terminal unit and a charging circuit disposed within the charging cradle. The charging terminals are disposed on the exterior of the charging cradle and are coupled to the charging circuit. The charging terminals are aligned to engage the battery charging contacts when the cordless terminal unit is engaged with the charging cradle.

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[12] In another specific embodiment of the cordless terminal unit, a handset that has the microphone and the speaker disposed therein is included. A cord couples

from the microphone and the speaker to the audio circuit. In another specific embodiment, a handset having the microphone, the speaker, and the user interface disposed therein is provided. A cord couples from the microphone and the speaker to the audio circuit, and also couples from the user interface to the transceiver.

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[13] In a particular embodiment, a wireless telephone node for providing telephony access between plural cordless telephone terminal units and the public switched telephone network is disclosed. The node comprises a wireless transceiver adapted to communicate wireless telephony signals with a wireless telephone
10 network. A first processor is adapted to convert wireless audio signals and wireless control signals from the wireless telephony signals. A cordless transceiver is adapted to communicate cordless telephone signals with the plural cordless telephone terminal units. A second processor is adapted to convert plural cordless audio signals and cordless control signals from the cordless telephone signals. A switch is coupled to
15 connect the wireless audio signals and the plural cordless audio signals. A controller is coupled to cause the switch to connect any two of the wireless audio signals and the plural cordless audio signals in response to the wireless control signals or the cordless control signals. A subscriber identity module interface is adapted to accept subscriber identity modules having user wireless account identities and data stored therein, which
20 is coupled to the controller. The controller is operable to transfer user account identity data from the subscriber identity module interface to the first processor for communications to the wireless telephone network.

[14] In a refinement of the foregoing wireless telephone node, plural subscriber
25 identity module interfaces are coupled to the controller for accepting plural subscriber identity modules. A subscriber identity module actuator is coupled to the controller for selecting one of the plural subscriber identity modules interfaces from which to

transfer user account identity data. In a further refinement, each of the plural subscriber identity module interfaces corresponds to a unique word of cordless control signal data corresponding to a particular one of the of the plural cordless telephone terminal units. In another refinement, one of the plural subscriber identity modules
5 interfaces is selected according to a unique word of cordless control signal data received by the cordless transceiver.

[15] In a particular embodiment of the present invention, a wireless telephone node system for providing telephony access between plural cordless telephone handsets
10 and the public switched telephone network is disclosed. The node includes a wireless transceiver adapted to communicate wireless telephony signals with a wireless telephone network, and a first processor adapted to convert wireless audio signals and wireless control signals from the wireless telephony signals. There is a cordless transceiver adapted to communicate cordless telephone signals with the plural cordless
15 telephone handsets and a second processor adapted to convert plural cordless audio signals and cordless control signals from the cordless telephone signals. A first landline interface circuit is adapted to communicate telephone signals via metallic connection to the public switched telephone network. A third processor is coupled to convert landline telephone signals to landline audio signals and landline control signals.
20 A switch is coupled to connect the wireless audio signals, the plural cordless audio signals, and the landline audio signals, with a controller coupled to cause the switch to connect any pairs of the wireless audio signals, the plural cordless audio signals, and the landline audio signals in response to the wireless control signals, the cordless control signals, or the landline control signals.

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[16] In a refinement to the foregoing wireless telephone node, the node further includes a second landline interface circuit coupled to the third processor, wherein the

third processor outputs plural landline audio signals to the switch. In a further refinement, the node includes a line selection actuator coupled to the controller, wherein actuation of the line actuator selects either the wireless transceiver or the landline interface circuit as an access resource to the public switched telephone network. In another refinement, a word of cordless control signal data causes the controller to select either the wireless transceiver or the landline interface circuit as an access resource to the public switched telephone network.

[17] In a particular embodiment of the present invention, a wireless telephone node system for providing telephony access between plural cordless telephone handsets and the public switched telephone network is taught. The node includes a plural wireless transceivers adapted to communicate plural wireless telephony signals with a wireless telephone network. Also, a first processor is adapted to convert wireless audio signals and wireless control signals from each of the plural wireless telephony signals. A first cordless transceiver is adapted to communicate cordless telephone signals with the plural cordless telephone handsets. A second processor is adapted to convert plural cordless audio signals and cordless control signals from the cordless telephone signals. A switch is coupled to connect the plural wireless audio signals and the plural cordless audio signals, with a controller coupled to cause the switch to connect any pair of the plural wireless audio signals and the plural cordless audio signals in response to the plural wireless control signals or the cordless control signals.

[18] In a refinement to the foregoing wireless telephone node, the node further includes a line selection actuator coupled to the controller, wherein actuation of the line actuator selects one of the plural wireless transceivers as an access resource to the public switched telephone network. In a further refinement, the node operates such that a word of cordless control signal data causes said controller to select one of the

plural wireless transceivers as an access resource to the public switched telephone network.

BRIEF DESCRIPTION OF THE DRAWINGS

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Figure 1 is a diagram of a three-handset wireless node system according to an illustrative embodiment of the present invention.

Figure 2 is a back view of a wireless node according to an illustrative embodiment of the present invention.

10 Figure 3 is a side view of a wireless node according to an illustrative embodiment of the present invention.

Figure 4 is a front view of a wireless node according to an illustrative embodiment of the present invention.

15 Figure 5 is a top view of a four-handset wireless node according to an illustrative embodiment of the present invention.

Figure 6 is a side view of a four-handset wireless node according to an illustrative embodiment of the present invention.

Figure 7 is an end view of a four-handset wireless node according to an illustrative embodiment of the present invention.

20 Figure 8 is a diagram of a three-handset wireless node system according to an illustrative embodiment of the present invention.

Figure 9 is an application drawing of a three-handset wireless node system according to an illustrative embodiment of the present invention.

25 Figure 10 is a top view of a wireless node according to an illustrative embodiment of the present invention.

Figure 11 is a side view of a wireless node according to an illustrative embodiment of the present invention.

Figure 12 is a front view of a wireless node according to an illustrative embodiment of the present invention.

Figure 13 is a drawing of a wall-mount wireless node and handset according to an illustrative embodiment of the present invention.

5 Figure 14 is a drawing of a tabletop wireless node and handset according to an illustrative embodiment of the present invention.

Figure 15 is a drawing of a desk-clock wireless node according to an illustrative embodiment of the present invention.

10 Figure 16 is a drawing of an AF-FM radio wireless node according to an illustrative embodiment of the present invention.

Figure 17 is a drawing of a "2500 set" style cordless telephone according to an illustrative embodiment of the present invention.

Figure 18 is a drawing of a wall-mount style cordless telephone according to an illustrative embodiment of the present invention.

15 Figure 19 is a drawing of a headset style cordless telephone according to an illustrative embodiment of the present invention.

Figure 20 is an application drawing of a headset style cordless telephone according to an illustrative embodiment of the present invention.

20 Figure 21 is a functional block diagram of a wireless node according to an illustrative embodiment of the present invention.

Figure 22 is a functional block diagram of a wireless node with clock according to an illustrative embodiment of the present invention.

Figure 23 is a functional block diagram of a wireless node with AM/FM radio according to an illustrative embodiment of the present invention.

25 Figure 24 is a functional block diagram of a headset style cordless telephone according an illustrative embodiment of the present invention.

Figure 25 is a functional block diagram of a wall-mount or desktop style cordless telephone according an illustrative embodiment of the present invention.

Figure 26 is a functional block diagram of a “2500 set” style cordless telephone according an illustrative embodiment of the present invention.

5 Figure 27 is a functional block diagram of a “princess” style cordless telephone according an illustrative embodiment of the present invention.

Figure 28 is a drawing of a multiple-handset wireless node system with SIM modules and landline interface according to an illustrative embodiment of the present invention.

10 Figure 29 is a functional block diagram of a multiple-handset wireless node system with SIM modules, plural wireless transceiver, and plural landline interfaces according to an illustrative embodiment of the present invention.

DESCRIPTION OF THE INVENTION

5 [19] Illustrative embodiments and exemplary applications will now be described with reference to the accompanying drawings to disclose the advantageous teachings of the present invention.

[20] While the present invention is described herein with reference to illustrative
10 embodiments for particular applications, it should be understood that the invention is not limited thereto. Those having ordinary skill in the art and access to the teachings provided herein will recognize additional modifications, applications, and embodiments within the scope thereof and additional fields in which the present invention would be of significant utility.

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[21] The present invention provides a wireless node and system that couples wireless telephone resources to a multiple handset cordless telephone system. Portability of the system is enhanced through use of battery power, AC adapters and a modular design approach. Cordless handsets are provided that are consistent with
20 prior art cordless designs, as well as unique designs that emulate traditional wire-line telephones for added user convenience. A complete portable telephone system is taught that allows users to take their telephone system, and telephone number, with them while they travel away from home or office.

25 [22] Reference is directed to Figure 1, which is a diagram of three-handset wireless node system according to an illustrative embodiment of the present invention. A wireless node 2 incorporates hardware and circuitry to enable communications with

both a wireless network 8 and with multiple cordless terminal units 4. The wireless node 2 includes a wireless antenna 12 that communicates wireless signals 10 with a wireless network 8. The wireless network can be any of those presently deployed, which includes but is not limited to, AMPS networks, TDMA networks, CDMA networks, GSM Networks, the T-Mobile network, or other networks known to those skilled in the art. The network may also be one of those that may later be deployed or later becomes know to those skilled in the art. The essential aspect of the wireless network 8, with respect to the present invention, is that wireless audio signals and wireless control signals are transmitted within wireless signals. Further, that the wireless transceiver (discussed herein after) within the wireless node 2 is adapted to convert the audio and control portions of the wireless signals for use in subsequent processing.

[23] In addition to wireless communications 10, the wireless node 2 also includes a cordless communications antenna 14 for communicating cordless signals 6 with multiple cordless handsets 4. The radio frequency bands and protocol used in the cordless radio signals 6 may be any of those known to those skilled in the art, or that later become known to those skilled in the art. These include, but are not limited to the 900MHz cordless band, the 1.8 GHz cordless band, the 2.4 GHz cordless band, and the 5.8 GHz band. The particular signaling protocol may operate in accordance with, but is not limited to, an analog standard, a digital standard, the PHS standard, the DECT standard, and the various DSS protocol standards. What is essential with respect to the present invention is that the cordless transceiver (discussed herein after) within the wireless node 2 is operable to convert plural cordless audio signals and cordless control signals from the cordless signals 6. And, that the cordless signals are transmitted between the plural cordless terminal units 4 and the wireless node 2.

[24] The wireless node 2 includes a power connector 18, which allows connection of external power, such as from a wall plug mounted AC transformer. In an illustrative embodiment, the wireless node 2 includes a self-powered battery (not shown) that is charged through battery charging contacts 16 disposed on the exterior of the wireless node case 2. A charging cradle 20 is provided that has corresponding charge terminals 22 aligned to engage the wireless node 2 battery charging contacts 16 while the wireless node 2 is engaged in the charging cradle 20. The charging cradle 20 receives power through an input connector 23 that couples to a wall-mount AC transformer 24, as are known to those skilled in the art.

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[25] The wireless node 2 communicates cordless signals 6 with plural cordless terminal units 4. The multiple cordless terminal units 4 are able to access the wireless network 8 and are able to access one another in an intercom operation. Thus, any one of the plural cordless terminal units can receive a telephone call from, or place a telephone call to, the wireless network 8. In an illustrative embodiment, multiple wireless telephone numbers can be assigned to the wireless node 2 by the wireless network 8, and the wireless node 2 is able to route each unique wireless telephone number to a particular one of the plural cordless terminal units 4. This is possible because each of the cordless terminal units 4 is assigned a unique identity within the cordless telephone protocol. Since each cordless terminal unit 4 has a unique identity, any of the cordless terminal units 4 is able to place a call to any other cordless terminal unit by addressing the unique identity of the desired unit. Addressing of either a telephone number or the unique identity of another cordless terminal unit is accomplished with a telephone keypad 32 on the cordless terminal unit 4. A display 30 is provided to enable user interface display of the called number or identity, the calling number or identity, stored numbers, and various other user interface functions as are known to those skilled in the art. Each cordless terminal unit 4 also includes an

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earphone speaker 28 and a microphone 34 as part of the user interface. An antenna 26 communicates cordless signals 6 with the wireless node 2.

[26] Each of the cordless terminal units 4 is battery powered in the illustrative embodiment of Figure 1. To facilitate charging of the battery, each cordless terminal unit includes battery charging contacts 36 disposed on the exterior of the cordless terminal unit case 4. A charging cradle 38 is provided for each cordless terminal unit 4 which has corresponding charging terminals 40 that are aligned to engage the battery charging contacts 36 when the cordless terminal unit 4 is engaged in the charging cradle 38. Power to the charging cradle 38 is provided through a power input terminal 42, which may accept power from a wall-plug mounted AC transformer (not shown) as are known to those skilled in the art.

[27] Reference is directed to Figure 2, Figure 3, and Figure 4, which are a back view, a side view, and a front view, respectively, of a wireless node 44 according to an illustrative embodiment of the present invention. A notable feature of the present invention is the portability of certain illustrative embodiments. Portability is enhanced by battery power, yet it is desirable to maintain the size and weight of the cordless terminal units quite low. This dictates that a relatively small and low power battery be employed in the cordless terminal unit. It is less objectionable to use a larger, heavier, and more powerful battery in the wireless node. An advancement in the art is illustrated with a wireless node 44 that employs a charging cradle 46 adapted to engage and charge a cordless terminal unit 60. The wireless node 44 includes a wireless antenna 56 for communicating wireless signals with a wireless network, and a cordless antenna 58 for communicating cordless signals with a cordless handset 60. The charging cradle 46 is formed on a broad surface of the node 44 and includes charging terminals 48 and a retentive latch 50 for locking the cordless terminal in place

when engaged with the charging cradles 46. The more powerful battery (not shown) within the wireless node 44 provides charging power to the battery (not shown) in the cordless terminal 60 while the two are engaged. The wireless node can also be powered or recharged by an external source. Either a wall plug mounted transformer can provide power through the power connector 54 on the wireless node 44, or the wireless node can be placed in a charging cradle (not shown) with power connected through charging contacts 52. Thus it is appreciated that the wireless node can operate from its own battery reserve or from outside power sources, and that the wireless node can provide a point of support and a supply of power to the cordless terminal unit. The wireless node may also include an optional display 62 and keypad 64, as are known to those skilled in the art, for providing a user interface for system programming and operation by the user or a service technician.

[28] Reference is direct to Figure 5, Figure 6, and Figure 7, which are a top view, a side view, and an end view, respectively, of a four-handset wireless node 66 according to an illustrative embodiment of the present invention. The wireless node 66 includes a wireless antenna 68 for communicating wireless signals with a wireless network, and a cordless antenna 70 for communicating cordless signals with plural cordless handsets 76. A handle 72 is formed on the top of the wireless node enclosure 66 as a portability convenience. A base 80 is formed on the bottom of the wireless node enclosure 66 to aid in stability. The wireless node 66 receives external power through a power connector 74, which may be coupled to a wall plug mounted AC transformer. The power is used to charge a high capacity storage battery (not shown) inside of the wireless node 66. The battery powers the wireless node circuitry and also provides power to four charging cradles 77 that engage the four cordless terminal units 76. Each charging cradle 77 includes a retentive latch 78 for locking the cordless terminals 76 in their respective cradles 77. When the cordless terminal units 76 are locked in place,

the system provides a convenient package for transporting a multiple extension telephone system from place to place.

[29] Reference is directed to Figure 8, which is a diagram of a three-handset wireless node system 98 according to an illustrative embodiment of the present invention. A wireless antenna 118 communicates wireless signals 120 with a wireless network 122. A cordless antenna 115 communicates cordless signals 116 with any of the cordless terminal units 100. Three charging cradles 102, 104, and 106 are formed on the surface of the wireless node 98. An indicator 107 associated with charging cradle 106 activates when the cordless terminal unit 100 is active, and similar indicators are associated with the other two charging cradles 102, 104. A display 112 indicates the status of the system, such as indicating and "In Use" status. A telephone keypad 108 is provided for enabling telephone and unique identity dialing from the wireless node 98. A function keypad 108 is provided to enable various functions unique to the wireless node 98. Figure 9 illustrates an application of the wireless node 98 and cordless terminal unit 100 in a camping environment.

[30] Figure 10, Figure 11, and Figure 12 illustrate a top view, a side view and a front view, respectively, of a wireless node according to an illustrative embodiment of the present invention. This embodiment illustrates an application where the wireless node 82 is mounted in a fixed position, such as in a home or office. One benefit of a fixed position wireless node is that it can replace a wire-line service with wireless service, thereby obviating the need for dual telephone numbers. Also, the position of the wireless node can be selected to be out of sight, or for optimum wireless performance. The wireless node 82 includes the wireless antenna 84 and the cordless antenna 86 as described herein before. A handle 88 is provided for ease of installation and convenience if the node 82 is ever moved. A pair of key-slots 94 are formed in

the exterior of the node enclosure 82 and are used to attached the node 82 with screws 96 to a vertical surface, such as a closet wall, etc. Those skilled in the art will appreciate that any number of wall mounting structures known to those skilled in the art could be applied to the wireless node 82. A power terminal 92 is provided for
5 coupling external power, such as from a wall plug mounted AC transformer. In the fixed installation embodiment, and external wireless antenna connector 90 is provided. This allows the user to attach an antenna that may be remote mounted for better radio reception and transmission performance.

10 [31] Figure 13 is a drawing of a wall-mount wireless node and handset according to an illustrative embodiment of the present invention. An advantage of the present invention is the great variety of terminal unit configurations that are possible. This is beneficial because different users operating in different environments can have a telephone suited to their needs, yet still employ the advancements of the wireless
15 node of the present invention. In Figure 13, the wireless node 124 is configured as a wall mount cradle that may include some user interface functions. These functions can include a secondary dialing keypad, an "in use" indicator, dedicated functions keys, and other user interface features known to those skilled in the art. A wireless signal antenna 130 and a cordless signal antenna 128 are provided. The cordless
20 terminal unit rests on a cradle of the wireless node 124. This enables charging of the cordless terminal unit 126 and ready access to the display on the cordless terminal unit, including a caller ID display. It should be noted that since the wireless node 124 supports multiple cordless terminal units in a multiple handset environment, other kinds of cordless terminal units can be used in the vicinity of the wireless node 124.

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[32] Figure 14 is a drawing of a tabletop wireless node and handset according to an illustrative embodiment of the present invention. This embodiment is very similar to

the previously discussed embodiment, except that Figure 14 is configured for tabletop operation. The wireless node 132 rests on a horizontal surface and presents a charging cradle to receive the cordless terminal unit 134 and to charge its battery as well. The wireless signal antenna 136 and cordless signal antenna 138 are also present. The same user interface options are also possible with this embodiment.

[33] The physical structure of the wireless node of the present invention is used advantageously in a multiple terminal unit cordless telephone system. As has been noted above, the wireless node can serve as a docking station for one or more terminal units. It can provide the space and circuitry to accommodate a high capacity storage battery. It can be configured for wall or table mounting, or adapted for portability. Figure 15 is a drawing of another advantageous application of the present invention. In Figure 15, a desk-clock wireless node according to an illustrative embodiment of the present invention is shown. The wireless node 140 includes the familiar wireless signal antenna 142 and cordless signal antenna 144. A power connector 150 is present for connection of external power, or an internal battery may be provided. A clock display 146 is added along with typical clock control function buttons 148. This design makes the wireless node useful as a tabletop, or wall mounted appliance. Designer schemes can be applied to match various decors.

[34] In a similar vein to the wireless node clock, Figure 16 illustrates an AF-FM radio wireless node according to an illustrative embodiment of the present invention. The wireless node 152 includes the wireless signal antenna 162 and the cordless signal antenna 164. A pair of stereo speakers 156 is housed in the wireless node 152 together with a radio receiver (not shown). The radio user interface is present including a tuning display 154, volume and channel selection knobs 158 and some dedicated function buttons 160 as are typical for that type of radio receiver. An

additional antenna is required for the radio receiver, which can be internal to the wireless node 152, connected to an external antenna connector, or can be shared with the cordless or wireless antennas. Those skilled in the art will appreciate that any desirable radio or television band receiver could be included in the wireless node 152.

5 For example, a NOAA weather radio or TV audio receiver could be included.

[35] One application of the present invention is that a wireless telephone transceiver is used as a replacement for a wire-line telephone resource in a telephone system. Traditionally, users have had limited expectations about what a wireless
10 telephone is like. These basically include stand-alone handsets and vehicular mounted systems, often times with complex or cumbersome user interfaces. By applying the wireless node concept of the present invention, the cordless radio link separates the wireless part of the system from the terminal unit part of the system. Thus, the terminal unit can be produced in a variety of configurations. Some examples include a
15 cordless headset or handset. Other examples or cordless products that emulate convention corded telephones used in direct PSTN connection systems. While this concept may seem counter-intuitive to what users expect in wireless and cordless products, in is rather sensible when one considers that the wireless node of the present invention is meant, in some applications, to replace wire-line service. Thus,
20 users with expectations consistent with wire-line technology can have a terminal unit meeting their expectations. Users with expectations consistent with current wireless or cordless technology can also have their expectations met.

[36] Reference is directed to Figure 17, which is a drawing of a "2500 set" 166 style
25 cordless telephone according to an illustrative embodiment of the present invention. The "2500 set" nomenclature is derived from the pre-divestiture Bell Operating Systems classic desk telephone that was called the "2500 set." Such a device is

known to those skilled in the art. A “2500 set” enclosure 168 houses the cordless telephone circuitry, which is evidenced by the presence of a cordless signal antenna 174 extending from the housing 168. A conventional speaker-microphone handset 170 is coupled to the housing 168 by a conventional coiled cord 172. A telephone DTMF keypad 169 is present, and may include additional functions keys dedicated to the cordless specific features of the telephone. The “2500 set” embodiment is a comfortable design for users who prefer a traditional telephone, including the corded handset. Since the housing 168 is relatively large, a substantial battery can be installed, enable very extended periods of time before replacement or recharging are needed. This telephone terminal unit can be left at one place in a home or office, or the user can carry the entire set from room to room at will. In another embodiment of this same approach, the classic Bell Operating Systems “Princess Set” can be emulated. The case style is suitably changed, with the user interface dialing keypad placed in the handset, as was done with the original “Princess Set.”

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[37] Figure 18 illustrates a wall-mount style cordless telephone 176 according to an illustrative embodiment of the present invention. This design is consistent with expectations of cordless telephone users. The wall mount cradle 178 is fixed to a vertical surface. The handset 180 rests in the cradle 178 and its battery (not shown) is charged. A cordless signal antenna 184 extends from the handset 180. Note that the cordless signal antenna does not couple with an antenna on the base 178, but rather with a wireless node as described hereinbefore. A display is visible on the exposed side of the handset 180 so that users can check status or incoming calling party identification if available. The dialing keypad and other user interface controls are mounted on the handset. Note that there is no cord between the base and the handset.

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[38] Figure 19 illustrates a headset style cordless telephone 186 according to an illustrative embodiment of the present invention. A housing 188 contains the transceiver and associated circuitry, as well as a small battery. An ear support structure 190 is attached to the housing 188 and extends over the user's 196 ear to support the headset 186. A microphone support structure 194, in the form of a boom in the illustrative embodiment, supports and extends the microphone into receptive proximity to the user's 196 mouth. Other ear support structures and microphone support structures are known to those skilled in the art and may be applied to the illustrative embodiment. Figure 20 illustrates a typical application of the headset 186 by a user 198 in a vehicle 200 in a hands-free mode of operation. Note that the wireless node would be located elsewhere in the vehicle.

[39] The foregoing descriptions of the illustrative embodiments of the present invention articulated the exterior design, structure, and features generally. What follows is a series of discussion, with corresponding drawing figures, of the internal functional design of the wireless nodes and cordless terminal units in the illustrative embodiments.

[40] Reference is directed to Figure 21, which is a functional block diagram of a wireless node 202 according to an illustrative embodiment of the present invention. A wireless antenna 206 couples signals to and from a wireless transceiver 204. The transceiver modulates and demodulates the encoded wireless signals to the base-band. A wireless processor 218 converts the base-band signals to a wireless audio signal portion and a wireless control signal portion. The signals are duplex signals. These portions may be analog or digital depending on the radio technology employed, which may be any of those known to people skilled in the art. The wireless control signals are coupled to a controller 216. On the cordless side of the wireless node 202, a

cordless signal antenna 210 couples cordless radio signals to a cordless transceiver 211. The cordless transceiver 212 modulates and demodulates the encoded cordless signals to the base-band. A cordless processor converts the cordless signals to plural cordless audio signals and cordless control signals. The signals are duplex signals. The
5 cordless control signals are coupled to the controller 216. The controller operates and provides functionality by execution of suitable source code that is programmed into a memory portion of the controller 216. Control signals to and from both the wireless processor 218 and the cordless processor 214 enable the call progress functions of the wireless node 202. Those skilled in the art will appreciate that any of a variety of
10 processors, microprocessors, controllers, microcontrollers, ASICs (application specific integrated circuits), signal processors, or other programmable devices may be used to embody the wireless processor 218, controller 216 and cordless processor 214. In fact a single such device may embody all three, or discrete devices may be used for each, and so forth.

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[41] The wireless audio signals and the plural cordless audio signals are coupled to switch 208, which serves to cross connect any two of these signals upon command of the controller 216. The technology utilized in the switch 208 will depend on the nature of the audio signals, which are controlled by the protocol and technology of the
20 transceivers. Analog signals lend themselves to circuit switching, while data signals lend themselves to multiplexed switching. A telecommunications cross-point switching device may be used, or a digital switching device. In fact, the controller 216 can be used as the switch 208 in certain applications. Those skilled in the art are familiar with various technologies suitable for implementing the switch 208. In
25 operation, as calls are processed, the controller 216 directs the switch 208 to couple calls from the wireless side to the cordless side or from different audio signals on the cordless side depending on the nature of the call.

[42] A user interface 220 is provided in the illustrative embodiment, and includes actuators for user access, indicators and a display. The implementation of such a user interface is known to those skilled in the art. A storage battery 250 is coupled to provide power to the various circuits in the illustrative embodiment wireless node 202. A battery charging terminal 224 is present to allow connection of an external power supply for charging the battery 222 or for directly powering the wireless node 202 and its various circuits. A charging circuit 226 is provided and includes plural battery charging contacts 228. The charging contacts 228 are disposed upon the charging cradles on the exterior of the wireless node 202 in the illustrative embodiment. Current from the battery 222 or from an external power source through charging terminal 224 can be used to power the charging circuit 228. The charging circuit connects and regulates current flow to charge the terminal unit batteries when terminal units are engaged in the wireless node 202 charging cradles.

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[43] Reference is directed to Figure 22, which is a functional block diagram of a wireless node 230 with a clock feature according to an illustrative embodiment of the present invention. The basic structure of the wireless node 230 is very similar to that in Figure 21. Most of the functional sections are identical. In Figure 22, a wireless antenna 234 is coupled to a wireless transceiver 232, which couples wireless signals to a wireless processor 246. The processor is further coupled to a controller 244 and to a switch 236. On the cordless side, a cordless antenna 238 is coupled to a cordless transceiver 242, which is further coupled to the controller 244 and the switch 236. A user interface 248 is presented and coupled to the controller 244. A storage battery 250 powers the various circuits in the wireless node 230. The storage battery 250 is charged through charging terminal 252, or the external power supplied to the charging terminal may be used to power the wireless node 230 directly, thereby obviating the

need for battery 250. The details of operation of the foregoing functional elements are the same as described with respect to the illustrative embodiment in Figure 21. In Figure 22, a clock and clock display 254 is added to the wireless node 230.

5 [44] Reference is directed to Figure 23, which is a functional block diagram of a wireless node 256 with an AM/FM radio feature according to an illustrative embodiment of the present invention. The basic structure of the wireless node 256 is very similar to that in Figure 21. Most of the functional sections are identical. In Figure 23, a wireless antenna 260 is coupled to a wireless transceiver 258, which
10 couples wireless signals to a wireless processor 272. The processor is further coupled to a controller 270 and to a switch 262. On the cordless side, a cordless antenna 264 is coupled to a cordless transceiver 268, which is further coupled to the controller 270 and the switch 262. A user interface 274 is presented and coupled to the controller 270. A storage battery 280 powers the various circuits in the wireless node 256. The
15 storage battery 280 is charged though charging terminal 282, or the external power supplied to the charging terminal may be used to power the wireless node 256 directly, thereby obviating the need for battery 280. The details of operation of the foregoing functional elements are the same as described with respect to the illustrative embodiment in Figure 21. In Figure 23, an AM/FM radio tuner with corresponding
20 antenna 278 is added to the wireless node 256. The antenna 278 may be internal to the wireless node 256, added as an external antenna by using an antenna connector, or may be shared with the wireless antenna 260 or the cordless antenna 264. The radio's user interface is incorporated into the wireless node 256 user interface 274. The elements of this user interface 274 include a tuning indicatory, tuning and volume
25 controls, as well as other dedicated radio function controls as are known to those skilled in the art.

[45] Reference is directed to Figure 24, which is a functional block diagram of a headset style cordless telephone 283 according an illustrative embodiment of the present invention. Housing 284 supports the various circuit components of the wireless headset 283. An antenna 292 couples cordless signals to and from a wireless node (not shown). The antenna 292 is coupled to a cordless transceiver 290 that modulates and demodulates cordless audio and cordless control signals. The cordless control signals are coupled to controller 289. The cordless audio signals are coupled to an audio circuit 294, which is adapted to couple directly to a speaker 296 and a microphone 300. A storage battery 288 provides power to all the circuitry in the headset 283. Battery charging terminals 304 are coupled to charge battery 288 while the headset 283 is engaged in a charging cradle (not shown). Control actuator(s) 302 are provided for activating the hook-switch function of the headset 283 and for limited control such as volume, power, and others known to those skilled in the art. An ear support structure 286 is coupled to housing 284, and a microphone support structure 298 is coupled to the housing 284 to support the microphone 300 in receptive proximity to the user's mouth.

[46] Reference is directed to Figure 25, which is a functional block diagram of a wall-mount or desktop style cordless telephone according an illustrative embodiment of the present invention. The cordless telephone is comprised of two components, the handset 306 and the charging cradle 326. The handset includes a cordless antenna 308 that couples cordless signals to and from a wireless node (not shown). The antenna 308 is coupled to a cordless transceiver 310 that modulates and demodulates cordless audio and cordless control signals. The cordless control signals are coupled to controller 320. The cordless audio signals are coupled to an audio circuit 312, which is adapted to couple directly to a speaker 314 and a microphone 316. A storage battery 322 provides power to all the circuitry in the handset 306. Battery charging terminals

324 are coupled to charge battery 322 while the handset 306 is engaged in a charging cradle 326. A user interface 318 is provided for dialing, activating the hook-switch function, and for other dedicated functions as are known to those skilled in the art. The charging cradle 326 includes a storage battery 330 that is coupled to a charging circuit 332. The charging circuit 332 receives power from external power source connector 336. The charging circuit provides power to battery charging contacts 334, which are aligned to engage charging terminals 324 of the handset 306 while it is engaged with the charging cradle 326. The source of power to the charging circuit 332 can be from the external source 336 or the internal storage battery 330. A wall or table mount structure 328 is provided for adapting the mounting options of the cradle 326.

[47] Reference is directed to Figure 26, which is a functional block diagram of a “2500 set” style cordless telephone according an illustrative embodiment of the present invention. The cordless telephone is comprised of two components, the base 338 and the handset 356. The base 338 includes a cordless antenna 340 that couples cordless signals to and from a wireless node (not shown). The antenna 340 is coupled to a cordless transceiver 342 that modulates and demodulates cordless audio and cordless control signals. The cordless control signals are coupled to controller 346. The cordless audio signals are coupled to an audio circuit 344, which is adapted to couple a speaker 358 and a microphone 360 through a coiled cord 354. The speaker 358 and microphone 360 are located in the handset housing 356. A storage battery 350 provides power to all the circuitry in the telephone. An external power connector 352 is coupled to charge battery 350. A user interface 348 is provided for dialing, activating the hook-switch function, and for other dedicated functions as are known to those skilled in the art. An AC power adapter 362 is provided, which is coupled to

external power connector 352 with plug 364 to charge battery 350, or to power the telephone directly.

[48] Reference is directed to Figure 27, which is a functional block diagram of a “Princess set” style cordless telephone according an illustrative embodiment of the present invention. The cordless telephone is comprised of two components, the base 366 and the handset 388. The base 366 includes a cordless antenna 368 that couples cordless signals to and from a wireless node (not shown). The antenna 368 is coupled to a cordless transceiver 370 that modulates and demodulates cordless audio and cordless control signals. The cordless control signals are coupled to controller 374. The cordless audio signals are coupled to an audio circuit 372, which is adapted to couple a speaker 384 and a microphone 386 through a coiled cord 380. The speaker 384 and microphone 386 are located in the handset housing 382. A storage battery 376 provides power to all the circuitry in the telephone. An external power connector 378 is coupled to charge battery 376. A user interface 388 is provided for dialing, activating the hook-switch function, and for other dedicated functions as are known to those skilled in the art. The user interface 388 is located in the handset 382 and is coupled to controller 374 through coiled cord 380. An AC power adapter 390 is provided, which is coupled to external power connector 378 with plug 392 to charge battery 376, or to power the telephone directly.

[49] Reference is directed to Figure 28, which is a drawing of a multiple-handset wireless node system with SIM modules and landline interface according to an illustrative embodiment of the present invention. In the illustrative embodiment of Figure 28, the wireless telephone node 402 is configured and styled in the form of a conventional desk-set telephone. The wireless node 402 operates within a system 400 comprised of the wireless node 402 and plural cordless telephone handsets 404,

406, and 408. Access to the public switched telephone network ("PSTN") is had though a wireless telephone network 410, such as a cellular telephone network, for example. Antenna 418 couples wireless telephone signals between a wireless transceiver (not shown) within the node 402 and the wireless network 410. Cordless
5 telephone signals are coupled through antenna 420 with the plural cordless telephone handsets 404, 406, and 408.

[50] In addition to obtaining PSTN service through wireless network 410, the node 402 in Figure 28 has further access to the PSTN 412 via a metallic connection 414 to
10 the PSTN 412, as is understood by those skilled in the art. Metallic telephony connections are referred to as "landlines" by those skilled in the art, as well as within this disclosure hereinafter. A conventional RJ-11 cable 416 couples from the PSTN wall jack 414 to an RJ-11 connector 426 in the wireless node. The connection 416 may include one or plural twisted pair connections, landlines, to the PSTN 412,
15 enabling the node 402 to access one or plural telephone line simultaneously.

[51] One of the cordless telephone handsets 404 can rest in a cradle 422 in the node 402, which is adapted to receive the handset 404. Battery charging contacts 424 on the node 402 and the handset 404 are aligned so that a power supply (not shown) in
20 the node 402 can charge batteries (not shown) in the handset 404 while it rests in cradle 422. The desk-set features of the node 402 include a conventional telephone keypad 432, which enables a user to conveniently dial numbers and enter control sequences from the node. A display 428 is provided, which indicates numbers, names, functions, and other operational parameters that may be employed in the user
25 interface of the node 402 and system 400. Since there may be plural wireless connections 410 and plural landline connections 416, the node is equipped with plural line selector actuators 430. By actuating one of the line actuators 430, the user is

enabled to select from among the plural PSTN telephone resources available to the node402.

[52] Each of the cordless telephone handsets 404, 406, and 408 comprises a user interface in the illustrative embodiment of Figure 28. Now, with respect to handset 408, the user interface will be described. And antenna 466 couples the cordless telephone signals with the node 402 antenna 420. Each handset includes an earphone 464 and a microphone 452, which are used in the conventional manner that is known to those skilled in the art. A display 462 is provided to display numbers, names, control functions, status, and icons of various sorts, as are known to those skilled in the art. TALK and END actuators 460 are provided for initiating and terminating telephone calls. A conventional telephone keypad 456 is provided to enable a user to enter numeric digits and control sequences, as are known to those skilled in the art. A pair of function actuators 454 are provided to enable the selection of custom functions in the device. Plural line selection actuators 460 are provided to enable a user to select from among the plural PSTN telephone access resources available in the node 402. When the user actuates on of the line selection actuators 460, a cordless control signal that identifies the selected line is transmitted from the handset 408 to the node 402. This control signal directs the node 402 to connect to the selected PSTN telephone resource.

[53] The illustrative embodiment of Figure 28 includes utilization of industry standard subscriber identity modules ("SIM"). A SIM is a postage-stamp sized integrated circuit device that includes random access memory. The SIM card is basically a tiny computing device that accesses stored data and computer functions. Within the SIM card is stored a user's unique identity and various parameters of personal information. Also includes, is personal data, such as a telephone book list of

names and numbers, etc. The SIM cards are portable and enable each user to transfer their identity from one telephone device to another. The SIM card is inserted into a compatible receptacle in each compliant device, enabling the user to transfer their identity and personal information. SIM card technology is known to those skilled in the art. In Figure 28, a SIM card receptacle 452 is provided to receive plural SIM cards.

[54] In the illustrative embodiment, the SIM receptacle 452 has four SIM card slots 436, 438, 440, and 442, which are adapted to receive and communicate with for SIM cards 444, 446, 448, and 450, respectively. There are four corresponding indicator lamps 434 that illuminate when a SIM card has been successfully inserted and electrically coupled to. The SIM card receptacle 452 allows plural users to insert their personal SIM card, and thereby their personal identity, into the node 402. Whether the node 452 has one or plural wireless transceivers, each user can access their personal identity, and thereby keep and protect their personal billing and air-time usage. Thus, the use of wireless services can be maintained as unique and personal to each identity. On the other hand, the identities may also be shared amongst plural users, if such an approach is desired.

[55] Reference is directed to Figure 29, which is a functional block diagram of a multiple-handset wireless node system with SIM modules, plural wireless transceivers, and plural landline interfaces according to an illustrative embodiment of the present invention. The wireless node system 500 includes two separate wireless transceivers 510 and 512 that are coupled to a single wireless antenna 507 through an antenna combining circuit 508. Antenna combining circuits are known to those skilled in the art. While a single wireless transceiver can serve plural users with plural identities, it is preferred to utilize plural wireless transceivers as this increases the

number of simultaneous telephone conversations that can be supported. A wireless processor 530 is coupled to the wireless transceivers 510 and 512. The wireless processor couples wireless signals with the transceivers 510 and 512. The wireless processor processes the wireless signals to and from wireless audio signals and wireless control signals. The wireless audio signals are coupled to a matrix switch 514 for interconnection with and between other telephone resources in the system, discussed hereinafter. The wireless control signals are coupled to and from a central controller 532, which has supervisory and control functions over the entire system. Thus, the controller 532 sends and receives wireless control signals with the wireless processor 530.

[56] The node system 500 in Figure 29 also includes two telephone landline subscriber line interfaces ("SLIF") circuits for coupling via metallic interface to the PSTN. While two SLIF circuits 502 and 504 are employed in the illustrative embodiment, any suitable number of SLIF circuits can be employed. The SLIF circuits 502 and 504 couple landline telephone signals with a landline processor 506. The landline processor converts landline audio signals and landline control signals to and from the landline telephone signals. Those skilled in the art are familiar with landline pulse and DTMF dialing strings, call progress signals, line voltages, and so forth. The landline audio signals are coupled to and from the landline processor 506 and the switch 514. The landline control signals are coupled to and from the landline processor 506 and the controller 532. Thus, the central controller 532 receives and generates suitable landline control signals during operation of the node system 500.

[57] A cordless transceiver 518 couples cordless telephone signals via radio waves with plural cordless terminal units (not shown) through antenna 516. The cordless telephone signals are coupled to cordless processor 534, which couples plural cordless

audio signals with switch 514, and couples cordless telephone control signals with controller 532. In an alternative embodiment, plural cordless transceivers can be employed. This approach is useful in the case where analog radio signaling is used, so that each cordless transceiver supports a single cordless telephone conversation at one time. In the illustrative embodiment of Figure 29, a digital cordless protocol is employed, such that a single transceiver can support plural simultaneous cordless conversations.

[58] The controller and processor structure illustrated in Figure 29 enable a central controller 532 to communicate all of cordless control signals, wireless control signals, and landline control signals. This enables the cross-communications amongst these various technologies. PABX functions can be readily implemented by controller 532, as will be appreciated by those skilled in the art. Calls can be originated from the wireless network, the PSTN via landline connection, or from any of the plural cordless terminal units. The controller analyzes the control data received and routes the call to the selected or specified destination. Any combination is possible. The audio connections are implemented by switch 514, which may be embodied as a cross-point switch in the digital or analog domains. Switch 514 can connect plural pairs of audio resources simultaneously, under control of controller 532. While the illustration in Figure 29 shows separate processors for wireless 530, cordless 534 and landline 506 signals, those skilled in the art will appreciate that this illustration is applicable as both structural and functional. In one embodiment, all of the processors, as well as the controller 532 functions are implemented as discrete routines in a single physical device, such as a digital signal processor.

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[59] Now, continuing with the description respecting Figure 29, a battery 538 and charging circuit 540 are employed such that the node 500 can operate in battery or line

power. The charging circuit 540 includes a charging output 552 for coupling to one or more cordless terminal units while they are docked in the node 500. The battery 538 of the node can be charged from line power with an external power source coupled to charging contacts 550. Those skilled in the art are familiar with such battery and power supply circuits. A user interface circuit 536 is provided within the node 500, and serves to drive the display, key actuators and indicator lamps that comprise the user interface. In addition, the user interface is coupled to plural line selection actuators 542, 544, 546, and 548. These actuators are provided to enable a user to select the telephone resource, wireless, landline, etc., for a particular call.

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[60] The node 500 in Figure 29 also includes a SIM card interface circuit 528 and plural SIM card interface slots 520, 522, 524, and 526. Each slot accepts a discrete SIM card, and the interface 528 is coupled to transfer SIM card data with the wireless processor 528. The wireless processor couples this data, in turn, with the main controller 532.

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[61] Thus, the present invention has been described herein with reference to a particular embodiment for a particular application. Those having ordinary skill in the art and access to the present teachings will recognize additional modifications, applications and embodiments within the scope thereof.

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[62] It is therefore intended by the appended claims to cover any and all such applications, modifications and embodiments within the scope of the present invention.

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WHAT IS CLAIMED IS: